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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application Number: 10/600,991
Filing Date: June 19, 2003
Appellant(s): CHEN ET AL.

Daniel J. Krueger (Reg. No. 42,271)
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 2/7/2007 appealing from the Office action mailed 9/8/2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is incorrect. A correct statement of the status of the claims is as follows:

Claims 10-25 allowed.

Claim 4 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

This appeal involves claims 1-3 and 5-9.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is substantially correct. The changes are as follows:

WITHDRAWN REJECTIONS

The following grounds of rejection are not presented for review on appeal because they have been withdrawn by the examiner.

Claim 4 (35 U.S.C. §103: Mezzatesta in view of Freedman)

Applicant's arguments, see pages 12-14, filed 2/7/2007, with respect to the rejection of claim 4 under 35 U.S.C. §103 have been fully considered and are persuasive. The rejection of claim 4 under 35 U.S.C. §103 has been withdrawn.

Claim Rejections - 35 USC § 101

Upon further consideration, the rejection of claims 1-4, 10-12, and 20 under 35 U.S.C. §101 has been withdrawn. The person of ordinary skill in the art at the time the invention was made would have clearly understood that the neural network trained on synthetic earth formations representing real earth formations selected to cover the operating range of a selected tool would have a real world practical application/use in processing actual logging signals from the selected tool to produce a log of the earth parameter.

Allowable Subject Matter

In light of the withdrawn rejections above:

Claim 4 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 10-12 and 20 are considered allowable for the same reasons as those stated for claims 13-19 and 21-25 in pages 14-15 of the Office Action mailed 9/8/2006.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

5,862,513	Mezzatesta	1-1999
3,954,006	Anderson	5-1976
5,184,079	Barber	2-1993

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-3 and 5 are rejected under 35 U.S.C. 102(b) as being anticipated by **Mezzatesta** (USPN 5,862,513).

Claim 1:

Mezzatesta anticipates:

- an artificial neural network trained with a set of synthetic earth formation models selected to cover the operating range of a selected logging tool based on sensitivity and resolution limits of the logging tool and based on realistic ranges of formation parameters (C3-9 especially "A separate ANN, in certain aspects, is created for each type of well-logging tool. Each such ANN may have its own training dataset of well-log tool responses (these training datasets contain measured actual real raw data for a real formation or synthetic responses derived based on such data)" C3L25-C6L35 and "based on known raw data obtained by a particular tool in various actual formations, an input earth model is produced that includes synthetic rather than raw data ... an earth model (e.g. a set of one or more models from a training set) which is introduced ... to an artificial neural network ... synthetically developed data for an actual tool and actual formation" C7L30-60 and C9L35-55; Also see Figure 1A; *It would have been clear to the person of ordinary skill in the art at the time the invention was made that* ***Mezzatesta*** *anticipates training an artificial neural network (ANN) for a*

selected logging tool using models. ***Mezzatesta*** *further anticipates those models being synthetically generated based data measured by the selected tool for real formations. The person of ordinary skill in the art at the time the invention was made would have clearly understood that these synthetically generated models which were specialized to a particular tool would be bounded by both realistic ranges of formation parameters (due to the use of actual formation measurements in generating the synthetic data) and the operating range of the selected logging tool, including sensitivity and resolution limits of that selected logging tool (due to use of the selected logging tool for measuring the actual formations in generation of the synthetic data).*).

Claim 2:

Mezzatesta anticipates:

- said logging tool output signals are a series of samples each representing the signal at a depth point in said borehole (C3-9 especially "the model of the subsurface for training the ANNs includes variations in material properties in one, two, and/or three spatial dimensions, i.e. where properties can vary with increasing distance form the borehole, along different azimuths or directions from the borehole, and where material properties vary with depth in the borehole" C3L64-C4L3 and C8L65-C9L20; Also see Figures 4A, 4B, and 4C), and
- said neural network has a plurality of inputs receiving the samples from a range of depths in the borehole and one output representing the parameter at a depth point within the range of depths (C3-9 especially C3L35-C4L35 and "inputting the input earth model to a primary trained artificial neural network to produce an output model that includes a set of synthetic tool responses for the wellbore logging tool for at least one point or for a plurality of points in the earth formation" C5L3-10 and C8L65-C9L20; Also see "Inputs" Figure 2 and "Neural Network Output" Figure 4C and "DEPTH" Figure 4C).

Claim 3:

Mezzatesta anticipates:

- said logging tool output signals are a series of samples each representing the signal at a depth point in said borehole (C3-9 especially "the model of the subsurface for training the ANNs includes variations in material properties in one, two, and/or three spatial dimensions, i.e. where properties can vary with increasing distance form the borehole, along different azimuths or directions from the borehole, and where material properties vary with depth in the borehole" C3L64-C4L3 and "diameter of invasion (L_{xo}) varies from zero to twenty inches ... FIG. 4c illustrates an output of a trained ANN" C8L65-C9L20; Also see Figures 4A and 4B), and
- said neural network has a plurality of inputs receiving the samples from a range of depths in the borehole and a plurality of outputs representing the value of the parameter at a plurality of depth points within the range of depths (C3-9 especially C3L35-C4L35 and "inputting the input earth model to a primary trained artificial neural network to produce an output model that includes a set of synthetic tool responses for the wellbore logging tool for at least one point or for a plurality of points in the earth formation" C5L3-10 and C8L65-C9L20; Also see "Inputs" Figure 2 and "Outputs" Figure 2 and "Neural Network Output" Figure 4C and "DEPTH" Figure 4C).

Claim 5:

Mezzatesta anticipates:

- creating a set of synthetic earth formation models selected to cover the operating range of a selected logging tool based on sensitivity and resolution limits of the logging tool and based on realistic ranges of formation parameters (C3-9 especially "A separate ANN, in certain aspects, is created for each type of well-logging tool. Each such ANN may have its own training dataset of well-log tool responses (these training datasets contain measured actual real raw data for a real

formation or synthetic responses derived based on such data)" C3L25-C6L35 and "based on known raw data obtained by a particular tool in various actual formations, an input earth model is produced that includes synthetic rather than raw data ... an earth model (e.g. a set of one or more models from a training set) which is introduced ... to an artificial neural network ... synthetically developed data for an actual tool and actual formation" C7L30-60 and C9L35-55; *It would have been clear to the person of ordinary skill in the art at the time the invention was made that* ***Mezzatesta*** *anticipates modeling earth formation parameters surrounding a borehole including synthetically generating models that were specialized to a particular tool. The person of ordinary skill in the art at the time the invention was made would have clearly understood that these models would be bounded by both realistic ranges of formation parameters (due to the use of actual formation measurements in generating the synthetic data) and the operating range of the selected logging tool, including sensitivity and resolution limits of that selected logging tool (due to use of the selected logging tool for measuring the actual formations in generation of the synthetic data).*);

- generating synthetic responses of the selected tool to each of the formation models (C3-9 especially "Each such ANN may have its own training dataset of well-log tool responses (these training datasets contain measured actual real raw data for a real formation or synthetic responses derived based on such data)" C3L25-C4L62 and "training a first artificial neural network with an input training set, the input training set comprising a plurality of earth models based on wellbore logging data and further comprising a set of wellbore logging tool responses associated with each earth model, producing a first trained artificial neural network" C4L63-C6L35 and "based on known raw data obtained by a particular tool in various actual formations, an input earth model is produced that includes synthetic rather than raw data ... an earth model (e.g. a set of

one or more models from a training set) which is introduced ... to an artificial neural network ... synthetically developed data for an actual tool and actual formation" C7L30-60 and "well logging tool of the system in a borehole acquires a set of raw well logging data for a particular part of a formation adjacent to the well logging tool. The system, in this aspect, includes a computer appropriately programmed to process the well logging data to produce an input earth model. A trained artificial neural network program resident in the computer then processes the input earth model to produce an output model of synthetic tool responses for part of the formation" C9L35-55);

- using the synthetic responses and the formation models to train an artificial neural network to generate representations of formation models in response to the synthetic responses (C3-9 especially "inputting to a second artificial neural network both the input earth model training set and the first output set of synthetic tool responses for the well logging tool, producing a second trained artificial neural network which then serves as the primary trained artificial neural network" C4L63-C6L26; Also see Figures 1A and 1B); and
- processing actual logging signals from the selected tool with the trained neural network to produce a log of the earth parameter (C3-9 especially "conducted at a well site having a wellbore extending into the formation, the wellbore logging tool disposed in the wellbore; such a method including conducting a subsequent wellbore operation at the well site based on the output model" C6L5-31 and "acquisition of wellbore logging data and user thereof with a trained ANN to produce a formation model" C6L5-31; *The person of ordinary skill in the art at the time the invention was made would have clearly understood that* ***Mezzatesta*** *intended the use of the artificial neural network, subsequent to training, for processing actual logging signals to produce a wellbore log of appropriate parameters*).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 6 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Mezzatesta** (USPN 5,862,513) in view of **Anderson** (USPN 3,954,006).

Claim 6:

Mezzatesta teaches:

- using the synthetic responses and the formation models to train one or more additional artificial neural network or networks to generate representations of the formation models in response to the synthetic responses (C3-9 especially "first artificial neural network ... inputting to a second artificial neural network both the input earth model training set and the first output set of synthetic tool responses for the well logging tool, producing a second trained artificial neural network which then serves as the primary trained artificial neural network ... training the secondary artificial neural network producing a tertiary artificial neural network ... training a forth artificial neural network" C4L63-C6L26; Also see "NETWORK1" Figure 1A and "NETWORK1" Figure 1B and "NETWORK2" Figure 1B);
- processing the actual logging signals from the selected tool with the additional trained neural network or networks to produce an additional log or logs of the earth parameter (C3-9 especially "conducted at a well site having a wellbore extending into the formation, the wellbore logging tool disposed in the wellbore; such a method including conducting a subsequent wellbore operation at the well

site based on the output model" C6L5-31 and "acquisition of wellbore logging data and user thereof with a trained ANN to produce a formation model" C6L5-31; *The person of ordinary skill in the art at the time the invention was made would have clearly understood that* ***Mezzatesta*** *intended the use of the last artificial neural network, subsequent to training, for processing actual logging signals to produce a wellbore log of appropriate parameters*); and,

Mezzatesta fails to teach:

- combining the logs of the earth parameter to produce a composite log of the earth parameter.

Anderson teaches:

- combining the logs of the earth parameter to produce a composite log of the earth parameter (C4-18 especially "the measurement logs 40 and 41 are appropriately correlated ... over one another and provide the unique composite log" C8L65-C9L55 and Figures 2C, 4C, 6C, and 10C).

Motivation:

Mezzatesta and **Anderson** are from the same field of endeavor, borehole logging. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the teachings of **Mezzatesta** by combining the logs of the earth parameter to create a composite log as taught by **Anderson** for the benefit of making it so the viscosity of well bore fluids are not a factor in determining the fluid velocities (**Anderson** C9L40-55).

Claim 9:

Mezzatesta teaches:

- wherein the artificial neural network has a plurality of outputs, each providing an output corresponding to a different depth point in the borehole (C3-9 especially C3L35-C4L35 and "inputting the input earth model to a primary trained artificial neural network to produce an output model that includes a set of synthetic tool responses for the wellbore logging tool for at least one point or for a plurality of points in the earth formation" C5L3-10 and C8L65-C9L20;

Also see "Inputs" Figure 2 and "Outputs" Figure 2 and "Neural Network Output" Figure 4C and "DEPTH" Figure 4C);

Mezzatesta fails to teach:

- combining the plurality of outputs according to borehole depth points to produce a log of the earth parameter.

Anderson teaches:

- combining the plurality of outputs according to borehole depth points to produce a log of the earth parameter (C4-18 especially "composite log ... through each particular interval of the well bore" C8L65-C9L55 and Figures 2C, 4C, 6C, and 10C).

Motivation:

Mezzatesta and **Anderson** are from the same field of endeavor, borehole logging. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the teachings of **Mezzatesta** by combining the logs of the earth parameter according to depth points to create a composite log as taught by **Anderson** for the benefit of making it so the viscosity of well bore fluids are not a factor in determining the fluid velocities (**Anderson** C9L40-55).

Claim Rejections - 35 USC § 103

Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Mezzatesta** (USPN 5,862,513) in view of **Barber** (USPN 5,184,079).

Claim 7:

Mezzatesta fails to teach:

- wherein the selected logging tool is an induction logging tool having more than one transmitter receiver pair and the synthetic responses from the selected tool include responses from more than one transmitter receiver pair.

Barber teaches:

- wherein the selected logging tool is an induction logging tool having more than one transmitter receiver pair and the synthetic responses from the selected tool include responses from more than one transmitter receiver pair (C1-17 especially C1L13-60 and C8L60-C920).

Motivation:

Mezzatesta and **Barber** are from the same field of endeavor, borehole logging. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the teachings of **Mezzatesta** by producing the synthetic logging responses using an induction logging tool having more than one transmitter receiver as taught by **Barber** for the benefit of obtaining a desired response (**Barber** C1L48-51).

Claim 8:

Mezzatesta fails to teach:

- wherein the selected logging tool is an induction logging tool having both in-phase and quadrature output signals and the synthetic responses from the selected tool include both signals.

Barber teaches:

- wherein the selected logging tool is an induction logging tool having both in-phase and quadrature output signals and the synthetic responses from the selected tool include both signals (C1-17 especially C1L13-60 and "in-phase ... quadrature-phase" C8L60-C920; Also see "INDUCTION LOG MEASUREMENTS (INPHASE, QUADRATURE FOR EACH ARRAY)" Figure 13a).

Motivation:

Mezzatesta and **Barber** are from the same field of endeavor, borehole logging. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the teachings of **Mezzatesta** by producing the synthetic logging responses using an induction logging tool including both in-phase and quadrature output signals as taught by **Barber** for the benefit of providing sufficient information concerning the existence, depth location, quantity, etc., of oil and gas trapped in the formations (**Barber** C1L12-34).

(10) Response to Argument

Claims 1-3 (Mezzatesta)

Applicant's arguments filed 2/7/2007 have been fully considered but they are not persuasive. In Re pages 9-10, Applicant argues that **Mezzatesta** fails to anticipate training data being selected to cover the operating range of the logging tool.

Examiner disagrees. **Mezzatesta** recites "Each such ANN may have its own training dataset of well-log tool responses (these training datasets contain measured actual real raw data for a real formation or synthetic responses derived based on such data)" C3L25-C6L35 (emphasis added) and "based on known raw data obtained by a particular tool in various actual formations, an input earth model is produced that includes synthetic rather than raw data ... earth model (e.g. a set of one or more models from a training set) which is introduced ... to an artificial neural network ... synthetically developed data for an actual tool and actual formation" C7L30-60 (emphasis added). It would have been abundantly clear to the person of ordinary skill in the art at the time the invention was made that **Mezzatesta** anticipated training data for the neural network that was specifically formulated for a particular tool based on realistic ranges of formations parameters.

In Re page 10, Applicant argues that **Mezzatesta** is directed to the use of the trained neural network to generate synthetic tool responses, and NOT to the data used to train the neural network as required by claim 1.

Examiner disagrees. It is true that **Mezzatesta** does cover the use of the trained neural network to generate synthetic tool responses. However, **Mezzatesta** is also directed to the data used to train the neural network as required by claim 1. Specifically, **Mezzatesta** recites producing "an input earth model", the earth model including "a set of one or more models from a training set" being introduced to an artificial neural network (C7L30-60). **Mezzatesta** also recites training datasets containing synthetic responses derived based on real raw data for "created for each type of well-logging tool" (C3L25-50). Furthermore, **Mezzatesta** does also anticipate synthetic tool

responses generated by a neural network being used to train subsequent neural networks (C4L25-C6L35).

In Re pages 10-11, Applicant argues that **Mezzatesta** does not teach or suggest "a set of synthetic earth formation models selected to cover the operating range of a selected logging tool".

Examiner disagrees. **Mezzatesta** recites "based on known raw data obtained by a particular tool in various actual formations, an input earth model is produced that includes synthetic rather than raw data" C7L30-60. Therefore, it is abundantly clear that **Mezzatesta** anticipates specifically selecting synthetic earth formation models bounded by both realistic earth formations and the operating range of a selected logging tool. This is necessarily the case since the synthetic earth model(s) is/are based on measurements acquired by the selected tool. The person of ordinary skill in the art at the time the invention was made would have clearly and logically understood that the synthetic earth models of **Mezzatesta** (based on measurements of real earth formations taken by a particular logging tool) would be within the resolution and sensitivity limits of that particular logging tool. Furthermore, **Mezzatesta** recites a separate artificial neural network for each type of well-logging tool (C3L25-40). The person of ordinary skill in the art at the time the invention was made would have logically understood that **Mezzatesta** anticipates each separate artificial neural network being trained on synthetic earth formation models selected to cover the operating range of a particular selected logging tool. The rejection of claims 1-3 under 35 U.S.C. §102 as anticipated by **Mezzatesta** stands.

Claim 5 (Mezzatesta)

Applicant's arguments filed 2/7/2007 have been fully considered but they are not persuasive. In Re page 12, Applicant argues that **Mezzatesta** fails to anticipate "creating a set of synthetic earth formation models selected to cover the operating range of a selected logging tool based on sensitivity and resolution limits of the logging tool and based on realistic ranges of formation parameters".

Examiner disagrees. **Mezzatesta** anticipates this limitation for the reasons given above.

In Re page 12, Applicant also argues that **Mezzatesta** fails to anticipate "train[ing] an artificial neural network to generate representations of the formation models in response to the synthetic responses."

Examiner disagrees. **Mezzatesta** recites "inputting to a second artificial neural network both the input earth model training set and the first output set of synthetic tool responses for the well logging tool, producing a second trained artificial neural network which then serves as the primary trained artificial neural network" C5L15-60 (emphasis added). In other words, **Mezzatesta** trains an artificial neural network, using synthetic responses. The secondary trained neural network produces a secondary output model that includes a set of secondary synthetic tool responses (C5L15-60). The person of ordinary skill in the art at the time the invention was made would have logically understood the secondary output model including a set of secondary synthetic tool responses to be representations of the formation models.

In Re page 12, Applicant argues that "claim 5 recites a neural network for direct inversion of tool logging signals."

Examiner disagrees. The limitation of "direct inversion of tool logging signals" by a neural network is not found in claim 5. Applicant's argument is narrower than the claim language requires. The claims and only the claims form the metes and bounds of the invention. "Office personnel are to give the claims their broadest reasonable interpretation in light of the supporting disclosure. *In re Morris*, 127 F.3d 1048, 1054-55, 44USPQ2d 1023, 1027-28 (Fed. Cir. 1997). Limitations appearing in the specification but not recited in the claim are not read into the claim. *In re Prater*, 415 F.2d, 1393, 1404-05, 162 USPQ 541, 550-551 (CCPA 1969)" (MPEP p 2100-8, C2L45-48; p2100-9 C1L1-4). The Examiner has full latitude to interpret each claim in the broadest reasonable sense. The interpretation detailed above is reasonable.

The rejection of claims 1-3 under 35 U.S.C. §102 as anticipated by **Mezzatesta** stands.

Claims 6 and 9 (Mezzatesta in view of Anderson)

Applicant's arguments filed 2/7/2007 have been fully considered but they are not persuasive. In Re page 14, Applicant argues that "Mezzatesta fails to teach or suggest each element of claim 5 as explained previously, and Anderson is silent with regard to neural networks."

Examiner disagrees. **Mezzatesta** anticipates every limitation of claim 5 as detailed above. The rejection of claims 6 and 9 under 35 U.S.C. §103 as unpatentable over **Mezzatesta** and **Anderson** stands.

Claims 7 and 8 (Mezzatesta in view of Barber)

Applicant's arguments filed 2/7/2007 have been fully considered but they are not persuasive. In Re page 14, Applicant argues that "Mezzatesta fails to teach or suggest each element of claim 5 as explained previously, and Barber is silent with regard to neural networks."

Examiner disagrees. **Mezzatesta** anticipates every limitation of claim 5 as detailed above. The rejection of claims 7 and 8 under 35 U.S.C. §103 as unpatentable over **Mezzatesta** and **Barber** stands.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/BB/ June 18, 2007

Conferees:

David Vincent

Anthony Knight

DAVID VINCENT 6/19/07
SUPERVISORY PATENT EXAMINER